AIR QUALITY SURVEY
(TAGA 3000)
ACRIFORM ENGINEERING INC.,
NEWMARKET
AUGUST, 1989

SEPTEMBER 1990

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Jim Bradley, Minister/ministre

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ACRIFORM ENGINEERING INC., NEWMARKET

AUGUST, 1989

Report prepared for:
Air Resources Branch
West Central Region
Ontario Ministry of the Environment

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Executive Summary

At the request of the Central Region, the mobile TAGA 3000 unit of the Ministry's Air Resources Branch conducted an air quality survey in Newmarket on August 8, 9, 10, 11, 14, 15, 16 and 17, 1989. The survey objective was to determine the ambient concentrations of styrene (C_8H_8) and to chemically "fingerprint" the odours associated with Acriform Engineering Inc.

The survey crew noted styrene-like odours downwind of Acriform during most of the monitoring days. The intensity of this odour ranged from mild to strong. Analysis of the mass spectra of ambient air samples taken downwind of Acriform provided evidence for the following contaminants: acetone, C_2-alkyl benzenes (xylene, ethyl benzene), C_3-alkyl benzenes (propyl benzene, ethyl toluene, trimethyl benzene), methyl acrylate and styrene. Estimated concentrations for acetone, C_2- and C_3-alkylbenzenes ranged from 1 to 70 $\mu g/m^3$ for a 2-minute average.

Styrene was the most abundant contaminant downwind of Acriform. The thirty one half-hour averages acquired downwind of the plant showed styrene concentrations between 2 and 84 $\mu g/m^3$. The odour was perceived to be strong for styrene levels in the hundreds of $\mu g/m^3$ range. Instantaneous styrene concentrations as high as 523 $\mu g/m^3$ were recorded. The Ministry standard for a half-hour average concentration of styrene is presently 400 $\mu g/m^3$ and it is based on odour. There was no exceedence of the Ministry standard for styrene.

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1.0 Introduction

At the request of the Central Region of the Ontario Ministry of the Environment, the Air Resources Branch conducted a mobile air monitoring survey in the vicinity of Acriform Engineering Inc., Newmarket, during August, 1989. The Central Region expressed special interest in the levels of styrene originating from Acriform. A secondary objective of this survey was to provide information regarding the odourous compounds emanating from Acriform. The mobile Air Monitoring Unit (MAMU) #3, containing a TAGA 3000 mass spectrometer, was used for fingerprinting the odours and quantitating the ambient styrene levels.

The Acriform Engineering Inc. is located on Mulock Drive in the town of Newmarket. Acriform manufactures products such as kitchen sinks and hot tubs by polymerization of materials in a closed mold process. Note that styrene odours were present, however emissions from the plant's stacks were never visible during the survey. A detailed description of Acriform's blending and molding process is provided in Appendix B, along with the operating status and schedules of the pertinent processes during the survey period.

Presented here are the findings of the Acriform air monitoring study as determined by the mobile TAGA 3000 unit on August 8, 9, 10, 11, 14, 15, 16 and 17, 1989.

2.0 The TAGA "Fingerprinting" Technique

The Trace Atmospheric Gas Analyser (TAGA) model 3000 is a specialized single quadrupole mass spectrometer with a unique air sampling inlet system and ion source which operates at atmospheric pressure. Ambient air is sampled continuously at a high flow rate (100 l/min.) directly into the ionization chamber, where various classes of contaminants are selectively ionized through the addition of the appropriate chemical ionization (CI) reagents. For example, water vapour highlights ketones, aldehydes, alcohols and acids; ammonia highlights amines, amides and some ethers; benzene highlights aromatics and sulphurous species, and oxygen highlights phenols, chlorophenols and acids.

The ionization of pollutants yields a mixture of pseudo-molecular ions which are immediately subjected to mass analysis up to 250 amu (atomic mass units). Mass "fingerprinting" is achieved in approximately 20 minutes if all four CI reagents are employed. The chemical, or pollutant, fingerprint arises from the interpretation of the mass spectra for a given monitoring period. Since the analysis of TAGA 3000 data is based on mass spectral interpretation, the resultant chemical identifications are somewhat tentative, the degree of uncertainty dependant on the complexity of the air sample. Occasionally, parallel samples are collected by means of solid sorbent tubes and contaminants are confirmed by GC/MS at our laboratory.

Owing to the system's unique feature of direct air sampling, and atmospheric chemical ionization, the technique is highly sensitive to many polar organic pollutants in real-time. In general, the TAGA can detect volatile compounds which contain a heteroatom such as N, O, P, S, or halide. Typical real-time detection limits for the TAGA are in the range of 0.1 to 10 $\mu g/m^3$, depending on the type of chemical(s) and the complexity of the sample matrix.

Real-time quantitation of styrene is achieved using a unique ionization method in the APCI (Atmospheric Pressure Chemical Ionization) source of the TAGA systems. In the positive ion mode styrene is detected as $C_8H_8^+$ via charge transfer reactions initiated by molecular benzene ions. Calibration of the TAGA response to gaseous styrene is accomplished by injecting known amounts of styrene directly into the air stream via a motorized syringe drive. For this particular survey, a benzene solution containing styrene was used for calibrating the TAGA response to $C_8H_8^+$ molecular ions. The TAGA 3000 was calibrated at least three times for styrene over the concentration range 0-250 $\mu g/m^3$ a minimum of once daily. Appendix A lists the average TAGA responses along with the corresponding daily variations. The detection limits for styrene were typically 2 $\mu g/m^3$.

2.1 Survey Strategy

Basically, the survey strategy was to position the mobile TAGA unit downwind of Acriform during an odour episode and acquire air quality data. For this particular survey measurements were made only during daytime hours. Since one of the objectives of this survey was to chemically characterize any odours, mass spectral data were recorded at times when odours were persistent. Ideally odours must be present for at least 20 minutes, the time it takes to complete the fingerprinting process. Monitoring locations were selected using the following criteria:

1) wind direction and wind speed;
2) plume tracking (real-time target compound measurements while mobile)
3) presence of odours
4) type of chemicals detected (fingerprint)
5) road network and accessibility.

Wind speed and wind direction data, collected at a height of 10 meters, were displayed by the on-board computer system and updated every 30 seconds. The meteorological data ensured that the monitoring locations were downwind of Acriform.

Plume tracking refers to the real-time determination of the instantaneous concentrations of styrene while the TAGA unit was driven in the vicinity of Acriform. Provided the winds are steady and the styrene concentrations are above background levels, plume tracking can immediately reveal the highest ground level concentrations and the "best" monitoring locations.

In addition to downwind (source) monitoring, TAGA data were also acquired at locations upwind of Acriform (background). The source data was then background-corrected by simply subtracting the upwind signals from the downwind signals for each amu (amu). The net signal was attributed to the source, provided the winds were appropriate.

3.0 Results and Discussion

The mobile TAGA 3000 group conducted ambient air monitoring in Newmarket on August 8, 9, 10, 11, 14, 15, 16 and 17, 1989. A total of 4 chemical fingerprints of the ambient air were determined at four different locations downwind of Acriform Engineering Inc. A majority of the monitoring was conducted along Mulock Drive south of Acriform. Data were also collected in the residential areas to the north and east of the plant at distances up to approximately 1/2 km (see Map 1). Table 1 summarizes the downwind monitoring periods, sampling locations, local meteorological conditions, compounds detected downwind of Acriform and relevant comments. The concentrations quoted in Table 1 (odour fingerprints) are only estimates (within a factor of 5) since on-site calibrations were not performed except for the target compound, styrene. The half-hour average concentrations for styrene are reported in Table 2 together with the single highest instantaneous readings (SHR) of styrene recorded during the corresponding 30 minute sampling periods. Ambient styrene concentrations were determined exclusively during the daytime since Acriform only operated between 7:15 and 16:30 hours.

August 8

This was a warm, partly cloudy day with prevailing WNW winds up to 10 km/hr. Upon arrival in Newmarket at 09:20 hours, styrene odours were noted on Mulock Drive. Prior to any downwind monitoring, background levels and styrene calibration factors were established upwind of Acriform on Cane Parkway about 500 m NE of Mulock Drive. The TAGA unit was then moved to a location approximately 250 m SE of Acriform (Site A). Two consecutive half-hour averages (S01 and S02, Table 2) were recorded at this location while intermittent styrene odours of mild/moderate strength were present. The average ambient level of styrene was 27 $\mu g/m^3$ (S01), about 15 times lower than the Ministry standard, with instantaneous readings exceeding 200 $\mu g/m^3$ especially during strong odour episodes. Because of wind shifts, the odour weakened so that the half-hour average styrene concentration was only 5.2 $\mu g/m^3$ (S02) with maximum levels of about 50 $\mu g/m^3$. Consequently, a new downwind location (Site B) was selected and S03 (Table 2) was recorded; the half-hour average concentration was 56 $\mu g/m^3$, instantaneous levels exceeded 300 $\mu g/m^3$ twice and 500 $\mu g/m^3$ once. Note that the characteristic odour of styrene was perceived to be strong even at the 200 $\mu g/m^3$.

Later in the afternoon, winds were out of the west. The TAGA was moved to Kent Drive 10 m N of Mulock Drive; approximately 50 treated utility poles were piled just 30 m west of the TAGA. Intermittent styrene odours were noted but a "sweet" odour was also constantly present. The fingerprint taken revealed the presence of naphthalene and methylnaphthalene with approximate concentrations of 7 and 2 $\mu g/m^3$ for a 2-minute average. These aromatic hydrocarbons probably originated from the utility poles. No styrene measurements were made at this site. Two chemical fingerprints (01 and 02, Table 1) were recorded on Mulock Drive at sites A and B (Map 1). Analysis of the mass spectra revealed the presence of acetone, styrene, methyl acrylate and C_3-alkylbenzenes with corresponding estimated concentrations of 68, 9, 4 and 1 $\mu g/m^3$. The sensitivity of the TAGA towards styrene was established once again upwind of Acriform (Appendix A).

August 9

This was a warm, sunny day with brisk south winds. In the morning, the TAGA was used to track the styrene plume to Site C: Cane Parkway roughly 300 m downwind of Acriform. The half-hour average concentration of styrene (S04, Table 2) was 33 $\mu g/m^3$ with instantaneous readings over 250 $\mu g/m^3$ during the first 15 minutes. Note that styrene odours were not present during the last 15 minutes of this 30-minute time period. A second half-hour average (S05, Table 2) for styrene was recorded at site D.

Later in the afternoon, two more half-hour averages (S06 and S07, Table 2) were also measured at site D. Only mild odours were present and styrene levels were low, less than 5.6 $\mu g/m^3$. Note that site D is approximately 500 m downwind of Acriform, in the Wesley Brooks Memorial Conservation Area. In general the styrene levels north and west of the plant were lower presumably because the many trees prevented the odours from reaching the TAGA.

August 10

August 10 was a sunny, hot and humid day with SW winds. Mild styrene odours were present on Cane Parkway, approximately 200 m from Roywood Crescent (Site C). Two half-hour averages (S08 and S09, Table 2) acquired at this location showed average styrene concentrations of 9.9 and 6.3 $\mu g/m^3$. As the day before, levels were low possibly because of the tree-barrier between the TAGA and Acriform. Three upwind calibrations were performed one before noon and two after; average response factors for styrene are listed in Appendix A. Two more half-hour averages (S10 and S11, Table 2) were recorded on Oak Street (Site E) and on Cane Parkway (Site C). Average ambient styrene concentrations were at least 25 times lower than the Ministry standard of 400 $\mu g/m^3$. Odours were very intermittent; for example, during the half-hour monitoring period (S11) odours were present for only three minutes when the styrene levels were consistently at 150 $\mu g/m^3$.

August 11

The air monitoring on this cloudy, hot and humid day began with the collection of upwind data and the calibration of styrene on Cane Parkway just north of Mulock Drive. Following upwind sampling, the TAGA was moved to Site C and a half-hour average (S12, Table 2) was recorded. The average concentration of styrene was 30 $\mu g/m^3$ with instantaneous levels approaching 200 $\mu g/m^3$ which corresponded to the detection of moderately strong odours. Plume tracking was conducted for ten minutes in the area enclosed by Mulock Drive, Cane Parkway, Water Street and Bayview Avenue. Styrene odours were most noticeable along Oak Street between Penrose Street and College Street; maximum instantaneous styrene levels were only about 50 $\mu g/m^3$. Following a second upwind TAGA calibration, plume tracking around Acriform during 11:40-12:10 hours indicated that ambient styrene levels were less than 5 $\mu g/m^3$. The low levels correlated with the observation that styrene odours were absent. Note that Acriform's operations cease around noon on Fridays.

August 14

August 14 was a hot, hazy and humid day. Two half-hour averages (S13 and S14, Table 2) at site E starting at 11:13 hours and at 11:44 hours showed very low ambient styrene concentrations; the winds were variable and the styrene odours were intermittent and mild. The TAGA was calibrated for styrene upwind of Acriform at 12:30 hours. One hour later, a half hour average (S15, Table 2) was recorded downwind of the plant on Kent Street approximately 150 m north of Mulock Drive. Plume tracking was performed around Acriform during 14:15-15:30 hours; odours were not noticeable and styrene levels did not exceed 5 $\mu g/m^3$. Drastic changes in wind direction were noted and wind speeds progressively decreased so monitoring was halted for the day.

August 15

There was a light rain with light winds from the SSW on this day. No styrene odours were noted during 10:00 to 14:00 hours while plume tracking. However, odours were present near the Holland River about 50 m east of Cane Parkway. Unfortunately, it was not feasible to move the TAGA directly downwind of the Acriform plume. Without odours present, a half-hour (S16, Table 2) was initiated on Cane Parkway at site C. As expected the styrene levels were very low (less than 2 $\mu g/m^3$); it appeared that the TAGA was located outside the plume boundary. Upwind calibrations were performed at the south end of Steven Court at 12:30 hours. Plume tracking was then conducted in the Wesley Brooks Memorial Conservation Area approximately 500 m north of Acriform. Odours were not present and styrene levels were below the detection limit of 2 $\mu g/m^3$.

August 16

This was a warm, partially cloudy day with moderate NW winds. At 8:50 hours the styrene odours were fairly strong between Kent Drive and the CNR tracks particularly on Mulock Drive, 10 meters east of the CNR tracks. A fingerprint (03, Table 1) and two half-hour averages (S17 and S18, Table 2) were recorded at this site, G. Mass spectral analysis of the fingerprint indicated that only acetone and styrene were detected. The half-hour average concentrations of styrene were 49 and 15 $\mu g/m^3$. During the first half-hour average (S17) instantaneous styrene levels greater than 100 $\mu g/m^3$ were recorded for at least 10 minutes. On the other hand, the first 20 minutes of S18 showed styrene levels less than 25 $\mu g/m^3$ while for the remaining ten minutes styrene levels exceeded 200 $\mu g/m^3$. Six more half-hour averages (S19, S20, S21, S22, S23 and S24, Table 2) were measured at site G in the time period 11:42-15:47 hours during the presence of strong, yet intermittent styrene odours. An example of actual real-time data recorded from 13:20 to 13:50 hours (S22, Table 2) is shown in Figure 1. The large variations in the instantaneous concentrations are probably due to the variance in wind speeds and direction. Although the maximum instantaneous level of styrene was 507 $\mu g/m^3$, the concentration averaged over the 30 minute monitoring period was only 72 $\mu g/m^3$, which is well below the Ministry standard of 400 $\mu g/m^3$ for a half-hour average. In fact most of the half-hour averages measured during this survey showed profiles similar to Figure 1.

August 17

With winds predominantly from the north, four half-hour averages (S25, S26, S27 and S28, Table 2) were recorded on Mulock Drive (Site H). The average concentrations of styrene were progressively increasing with time: 16, 26, 28 and 52 $\mu g/m^3$. The highest and most persistent levels of styrene were recorded during 11:40-11:55 hours of the half-hour average S28. During this sampling period styrene odours were strong and the instantaneous concentrations were at the 200 to 450 $\mu g/m^3$ range. Starting at 11:55 hours, odours became very light; this was not surprising since operations at Acriform had halted during the lunch period 12:00-12:30 hours. In addition it was observed that odours were also mild around 10:00 and 14:00 hours for about 20 minutes. Three more half-hour averages (S29, S30 and S31, Table 2) were measured at site H following background sampling and styrene calibrations upwind of Acriform. In contrast to the morning's observations, odours became milder with time; average styrene concentrations were 53, 25 and 2.3 $\mu g/m^3$. The low value for the average S31 is undoubtedly due to wind shifts from the NNW to the N and occasionally NNE. A fingerprint (04, Table 1) was taken while styrene odours were mild and intermittent. The compounds detected were acetone, styrene, xylenes and C_3-alkylbenzenes.

4.0 Summary and Conclusions

The mobile TAGA 3000 unit conducted an air monitoring survey in Newmarket, Ontario on August 8, 9, 10, 11, 14, 15, 16, and 17 at the request of the Ministry's Central Region. The purpose of this survey was to determine ambient levels of styrene and to fingerprint the odours originating from Acriform Engineering Inc. The findings of this survey are summarized by the following points:

1) Styrene-like odours were noticeable, albeit intermittent downwind of Acriform. The odours were generally strongest along Mulock Drive. The odours were strong at times in residential areas to the north and east of the plant at distances up to approximately 500 m. Strong odour episodes coincided with the enhancement of styrene levels as recorded downwind of Acriform.

2) Mass spectral analysis of the odours (fingerprints) downwind of Acriform indicated the presence of acetone, xylenes, C_3-alkylbenzenes, methyl acrylate and styrene. Estimated maximum concentrations based on fingerprint data (Table 1) ranged from 4 to 70 $\mu g/m^3$ for a 2-minute average. With the exception of styrene, the compounds detected have relatively high detection odour thresholds (greater than 1000 $\mu g/m^3$) so that their contribution to the Acriform odour may be assumed to be negligible. Consequently, it is concluded that the odours from Acriform are mainly due to styrene.

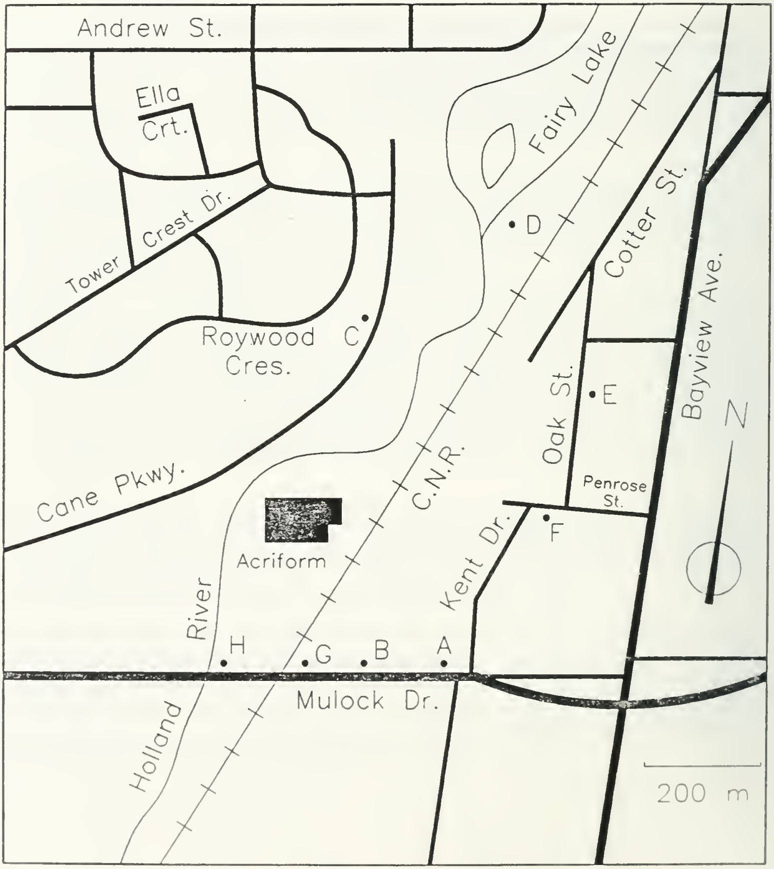
3) Styrene was the most abundant pollutant detected downwind of Acriform. Half-hour average concentrations of styrene range between 2 and 84 $\mu g/m^3$. The Ministry standard, 400 $\mu g/m^3$, is based on odour. The odour was perceived to be strong for styrene levels (instantaneous) in the hundreds of $\mu g/m^3$ range.

In conclusion, the survey results indicate that styrene is mainly responsible for the odours observed downwind of Acriform Engineering Inc. The contributions of the other detected contaminants, acetone, methyl acrylate and alkyl benzenes, towards the odours are probably minor. It is important to note that styrene odours were detected as far as 500 m from the plant. The half-hour average concentration of styrene never exceeded the Ministry standard of 400 $\mu g/m^3$; the highest value was 84 $\mu g/m^3$.

5.0 Acknowledgements

The author gratefully acknowledges the contributions of Mr. Ron Brooks of the Central Region and the TAGA 3000 survey crew:

Nicholas S. Karellas (SCIEX Consultant)
John V. Merritt (SCIEX Consultant)



Map 1. Monitoring Locations Downwind of Acriform Engineering Inc., Newmarket.

Table 1: Mobile TAGA 3000 Odour Fingerprints
Target Source: Acriform Engineering Inc.
Newmarket Survey 1989

Date	Fingerprint Number	Monitoring Period	Location[1]	Meteorological Conditions[2]			Compound[3] Detected	Comments
				AT	WS	WD		
Aug 08	01	14:19-14:25	A	19	10-20	NNW	C_3-alkylbenzene (1)	Mild woody odour
	02	14:36-14:49	B	18	15-25	NW	acetone (70) methyl acrylate (4) styrene (9)	Mild styrene odour
Aug 16	03	09:51-10:03	G	20	10-20	NW	acetone (20) styrene (5)	Mild styrene odour
Aug 17	04	16:04-16:27	H	22	05-15	N	acetone (40) styrene (2) xylenes (10) C_3-alkylbenzene (8)	Mild styrene odour

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Notes:

1. See Map 1 for sampling locations.
2. Met. conditions at 10 metres: AT=ambient temperature (°C); WS=range of wind speeds (km/hr); WD=predominant wind direction
3. Tentative identities based on interpretation of APCI/MS mass spectral data. Numbers in parentheses indicate estimated (± 5x) averaged concentrations in $\mu g/m^3$. C_3-alkylbenzene refers to mixture of propyl benzene, ethyl toluene and trimethyl benzene. For acetone, styrene and xylenes the Ministry standards are 48000, 400 and 2300 $\mu g/m^3$ respectively. The odour thresholds[a] are 40000, 20 to 640, and 3600 $\mu g/m^3$ respectively.

[a] Gemert van, L.J., (Central Institute for Nutrition and Food Research), Netenbreizer, A.H., (National Institute for Water Supply), "Compilation of Odour Threshold Values in Air and Water", Netherlands, 1977.

Table 2: Mobile TAGA 3000 Styrene Concentrations (1/2 Hour Ave.)
Newmarket (Acriform Engineering Inc.) Survey 1989

Date	Sample Number	Start Time	Location[1]	Meteorological Conditions[2] AT	WS	WD	Styrene Concentration[3] ($\mu g/m^3$) 1/2 hour Ave.	S.H.R.	Comments
Aug 08	S01	11:04	A	17	05-10	NW	27	266	Intermittent moderate odour
	S02	11:38	A	17	05-10	WNW	5.2	54	Mild odours
	S03	13:05	B	18	05-10	WNW	56	523	Moderate/strong odour
Aug 09	S04	09:41	C	17	05-10	S	33	267	Moderate odour
	S05	11:54	D	21	10-20	S	2.2	12	Very mild odour
	S06	14:21	D	22	10-15	SSW	5.6	47	Mild odour
	S07	14:54	D	23	10-20	SSW	2.9	29	No odour
Aug 10	S08	09:15	C	21	05-10	SSW	9.9	89	Mild odour
	S09	09:59	C	23	05-15	SSW	6.3	144	Mild odour
	S10	11:35	E	28	05-10	SSW	13	54	Mild odour
	S11	13:52	C	26	10-20	SSW	15	235	Mild odour
Aug 11	S12	09:32	C	24	00-01	N/A	30	194	Moderate odour
Aug 14	S13	11:13	E	28	05-10	SW	3.8	44	Mild odour
	S14	11:44	E	29	05-10	SW	<2.0	26	No odour
	S15	13:36	F	28	05-10	SW	2.8	64	Mild odour
Aug 15	S16	11:45	C	21	00-05	SSW	<2.0	9	No odour

(Table 2 cont'd)

Table 2: Mobile TAGA 3000 Styrene Concentrations (1/2 Hour Ave.)
Newmarket (Acriform Engineering Inc.) Survey 1989

Date	Sample Number	Start Time	Location[1]	Meteorological Conditions[2]			Styrene Concentration[3] ($\mu g/m^3$)		Comments
				AT	WS	WD	1/2 hour Ave.	S.H.R.	
Aug 16	S17	09:17	G	18	10-20	NW	49	288	Moderate/strong odour
	S18	10:06	G	20	10-20	NW	15	203	Strong odour
	S19	11:42	G	21	10-20	NW/N	11	174	Mild/strong odour
	S20	12:15	G	22	10-20	NW/N	8.3	258	Moderate/strong odour
	S21	12:47	G	22	10-20	NW/N	84	486	Strong odour
	S22	13:20	G	23	05-15	NW	72	507	Strong odour
	S23	14:47	G	24	05-15	NW	18	235	Odour present
	S24	15:17	G	24	10-20	NW	27	303	Odour present
Aug 17	S25	09:59	H	17	05-15	N	16	218	Odour present
	S26	10:30	H	18	10-20	N	26	279	Odour present
	S27	11:03	H	20	05-15	N	28	350	Odour present
	S28	11:33	H	20	05-15	NNW	52	457	Odour present
	S29	13:25	H	21	05-15	NNW	53	350	Moderate/strong odour
	S30	13:59	H	21	05-15	NNW	25	259	Moderate odour
	S31	14:31	H	22	05-15	N	2.3	39	Mild/moderate odours

Note: 1. See Map 1 for monitoring locations.
2. Met. conditions at 10 metres: AT=ambient temperature (°C); WS=range of wind speeds (km/hr);
WD=predominant wind direction.
3. For the uncertainties involved in the numbers listed above see Appendix A. S.H.R. refers to single highest reading during a half-hour average.

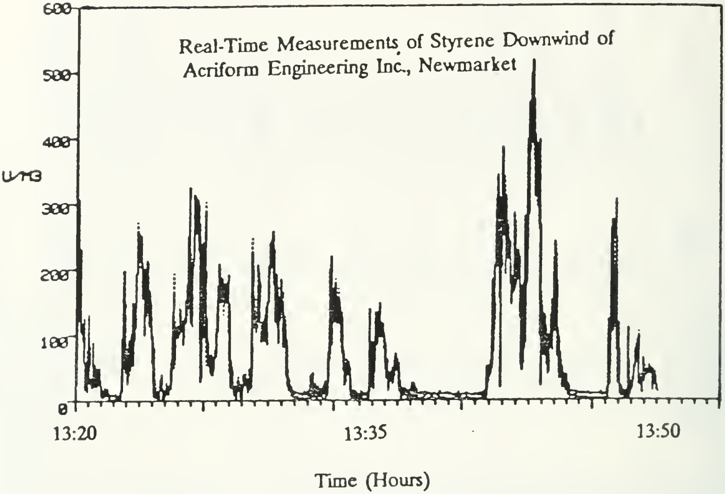

Figure 1. Real-Time Measurements of Styrene (S22, Table 2)
Recorded 16-August-1989, 13:20 - 13:50 Hours.
Monitoring Location: Site G (On Mulock Drive
≈10 m East of the CNR Tracks) Downwind of Acriform.
Measurement Technique: Mobile TAGA 3000 Unit.
Half-Hour Average Concentration: 72 $\mu g/m^3$.
Instantaneous (SHR) Peak Level: 507 $\mu g/m^3$.

Appendix A

Calibration[1] of styrene[2] (TAGA 3000): Newmarket Survey '89

Date	Time[3]	AT[4]	Slope[5]	Average# Slope[6]	Tcals	R2[7]
Aug 08	10:01	14	362±4%	593±39%	3	0.9985
	15:10	18	824±2%		3	0.9979
Aug 09	10:30	20	245±9%	238±3%	3	0.9994
	12:58	23	231±7%	440±47%	3	0.9980
	15:53	23	648±7%		3	0.9986
Aug 10	10:45	24	250±11%	303±17%	3	0.9988
	12:23	27	356±15%	371±4%	5	0.9993
	14:48	25	386±5%		3	0.9985
Aug 11	08:50	18	261±6%	403±35%	3	0.9995
	11:10	29	544±13%		3	0.9987
Aug 14	12:37	29	508±8%	508±8%	3	0.9982
Aug 15	12:30	20	252±8%	252±8%	3	0.9989
Aug 16	11:00	21	518±3%	745±30%	3	0.9985
	14:10	22	972±4%	1123±13%	4	0.9994
	16:00	23	1274±4%		3	0.9992
Aug 17	09:18	14	397±5%	528±25%	3	0.9988
	12:15	19	658±2%	636±3%	3	0.9987
	15:20	20	614±5%		3	0.9974

Note:
1. Calibrations were performed upwind of Acriform Engineering Inc.
2. Formation of styrene ions was achieved by benzene chemical ionization (CI). Linear response is in the concentration range of 0 - 250 $\mu g/m^3$.
3. Calibrations performed at indicated starting times; duration of calibrations was approximately 20 minutes.
4. AT = ambient temperature (°C) at time of calibration.
5. Slopes in ICPS/$\mu g/m^3$ of TAGA response curves measured consecutively. The ± variations are based on the number of consecutive calibrations (# Tcals).
6. Average slopes in ICPS/$\mu g/m^3$ used in determining the 1/2 hour average and instantaneous concentrations of styrene listed in Table 2. The ± variations are based on the time periods between calibrations.
7. Average correlation coefficients of linear plots of TAGA sensitivity (ICPS) vs. styrene concentration ($\mu g/m^3$).

Appendix B

Acriform Engineering Inc.
Newmarket

The following information was provided by the Central Region and Acriform Engineering Inc.:

Product

Acriform manufactures thermoformed acrylic bathtubs and kitchen sinks with fiberglass bases.

Process

Polymerization of material in a closed mold. The material asterite (trade name) contains methyl methacrylate monomer, crystalline silica, pigment/colour and catalyst (perkadox 16N) organic peroxide. The equipment consists of a mixing vessel and a pressure pot. Materials blended (closed vessel) are transferred to a pressure pot, during which process, the lid is open. The materials are transferred via closed system to mold which has a small air displacement vent. Emissions are released during the ten minute loading period. No other segments of the processes are exhausted to atmosphere.

Production Status

Hours of Operation:	07:15 - 16:30	Monday - Thursday
	12:00 - 12:30	Lunch
	07:15 - 12:30	Friday

Acriform Engineering Inc. was operating at a normal production level on August 8, 9, 10, 11, 14, 15, 16 and 17, 1989.

The exhaust system vents via 7 stacks 34 feet above grade. These stacks, located on the western section of the facility are 8 feet above the roof. Two other stacks are located on the east side of the facility, however, they emit no styrene.